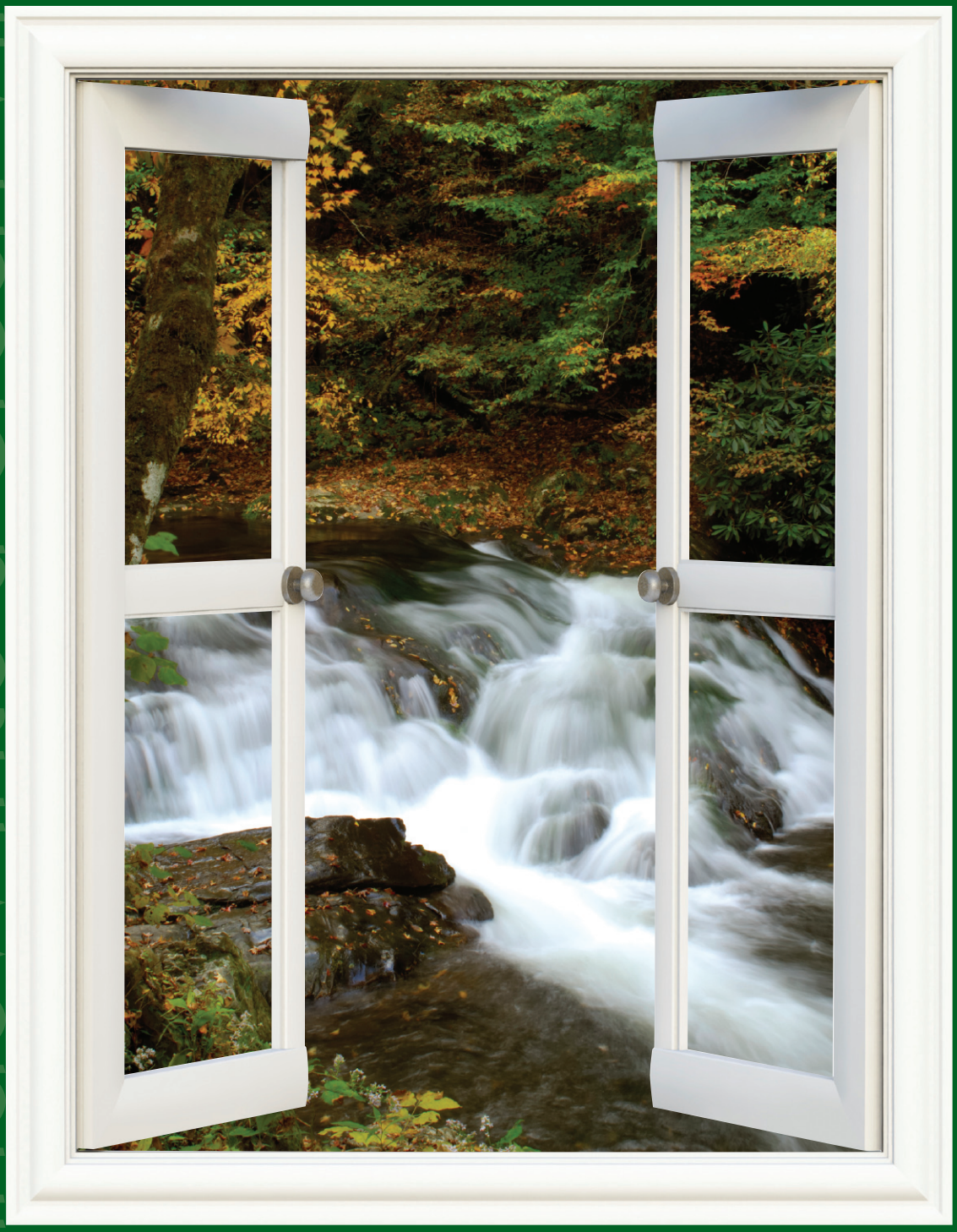
Window into a Green Virginia

V. Window into Water



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5.1 Introduction

All life on Earth is dependent upon the availability of water, but with increases in use and carelessness leading to pollution, usable sources are being depleted. Proper management of these water sources and the surrounding areas that help to naturally purify them will help reduce the negative effects of pollution. Students will learn about common threats to water sources and about the roles of wetlands surrounding many bodies of water.

Objectives

In this lesson students will:

- Investigate and understand the unique properties and characteristics of water and its role in the natural and human-made environment
- Understand the importance of water quality and the impacts that are associated with poor management practices upstream
- Familiarize themselves with organizations concerned with water quality.
- Use the Occoquan River as a present day case study in the clean-up of a major water source.
- Identify the characteristics of a wetland and policies surrounding the development of a wetland.

SOLs

Science 6.1, 6.5, 6.7, 6.9; English 6.2; Math 6.8

Key Terms/ Concepts

- Renewable Resources
- Non-Renewable Resources
- Sustainable Development
- Point Source Pollution
- Non-Point Source (NPS) Pollution
- Fecal Coliform
- Groundwater
- Hydric
- Hydrophytic
- Nutrient
- Recharge
- Reservoir
- Surface water
- Tributary
- Watershed
- Wetland

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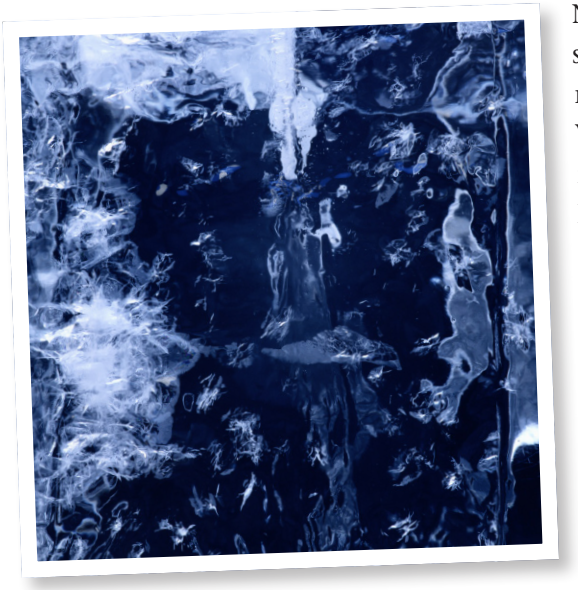
5.2 Student Information

In this Window, we discuss a very important molecule – water. Did you know that a majority of your body is made up of water? Water is needed by cells in the body to perform daily life processes. Humans can survive for weeks without food, but only a few days without water. You would think that since more than two-thirds of the Earth's surface is composed of water, we would never have to worry about running out, but only one percent is readily available for human use. Unfortunately, this small amount available is being threatened by pollution.

Do you ever find yourself just sitting around wondering how clean the water that you drink really is? How about the water in the creek behind your house where you and your dog play after school, or the river where you swim at summer camp, or that pond on your grandparents' farm where you love to go fishing. The cleanliness and quality of the water around you may seldom cross your mind; you just know that you enjoy spending time at these places.



Now imagine waking up one day and being told you can no longer play in the stream, swim in the river, or fish in the pond because the water quality has reached harmful levels. You're probably thinking, "Now that's just not fair!" You're exactly right; it isn't fair that you can no longer use these bodies of water for those recreational activities that you enjoy. But before you get too upset, let's look at some of the ways that water can be polluted and think about some of the solutions for protecting them.

Various forms of pollution threaten the quality of our water supply. Point source pollution is a form that can be traced back to its exact origin, such as waste discharging from a pipe that flows directly into a stream or river. Non-point source pollution is somewhat harder to identify, because the pollutants don't have a single identifiable source. For instance, run-off from fertilizer spread by a farmer could eventually make it into a water body.

In this Window, you will learn about the variety of water environments that may be found throughout Virginia. Can any of these settings be found near your home? What are potential sources of pollution in your area and how might you be able to prevent these pollutants from entering the ecosystem?

The survival of every organism not only in Virginia, but also on Earth must be ensured. You may be thinking, "What difference can I possibly make at such a young age?" Well, you are actually doing one of the most important things right now: becoming educated about the different effects that pollution has on Virginia's lakes, rivers, and streams. We can use this knowledge for the benefit of the environment, ensuring the protection and beauty of those waterways that we enjoy.

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5.3 Teacher Content

Managing renewable and non-renewable resources is key to sustainable use.

Natural resources are a vital part of our everyday life. Whether it's the paper you use to take notes, a sip of water from a water fountain, or even the gas used in the bus that brings you to school, natural resources provide many important goods and services to everyone, everyday. There are two main types of natural resources; renewable and non-renewable. Renewable natural resources are continually reproduced or can be produced as long as conditions will allow. Examples of renewable resources are trees, crops, and animals. Non-renewable or depletable resources cannot be reproduced or are limited in quantity. Non-renewable resources include minerals, oil, natural gas, and coal (Tietenberg). Water is one of the most important resources humans need to survive. We drink it, use it to clean things, and use it in manufacturing of many important products that we use everyday. Even though we cannot survive without clean, drinkable water, we tend to take it for granted.

Our supply of non-renewable resources will not last forever. To continue our current standards of living, there must be effective strategies for sustainable development. To achieve sustainable development, and not compromise the needs of future generations, we must all work together to help prevent the wasting of the resources we have now.

Point and non-point source pollution are major threats to water resources.

There are two major forms of pollution. These are point source and non-point source (NPS) pollution. **Point source pollution** comes from a single source and can easily be traced back to its originating point. Think of a pipe at a factory that discharges directly into a creek. This is an excellent example of point source pollution, because it is easy to see where the pollution is coming from. Because of concern over water pollution, the government has taken steps to reduce the amount of contamination. Pollutants are regulated by the Clean Water Act. The government has developed standards of treatment for domestic sewage and wastewater from industrial operations. Treatment plants must achieve these standards at a minimum. If local water quality conditions require it, even more stringent standards may be applied to these discharges. Point source pollution has received the most attention in recent years because it is relatively easy to regulate the source of discharge.

Non-point source (NPS) pollution is harder to locate and control simply because, as its name suggests, it does not come from a single point. These contaminants also cause damage to the water supply because they enter the water from many different sources. For example, one of Virginia's most pristine streams, Dragon Run in the Middle Peninsula, has recently had fish consumption advisories imposed on it by the State due to unsafe levels of toxic mercury, especially dangerous to pregnant women. Possible sources of the mercury may include deposition from the atmosphere or mercury emitted from coal-fired utility plants in the region and waste incinerator facilities (Springston 2004).

NPS pollution can come from agricultural and urban runoff. Farm runoff can result from plowing, fertilizing, and animal waste. Plowing loosens

soil that gets washed into lakes and streams during hard rains. Some fertilizer, such as nitrogen or phosphorus, does not get absorbed by the crops in fields. Those **nutrients** might then wash into the water supply during a heavy rain. The same is true for animal waste, which enters the water easily because livestock often have open access to a source of water, such as a pond or creek. Both fertilizer and animal waste contain nitrogen and phosphorus, which, when released into a water supply, may reduce the levels of oxygen present in the water. Nitrogen, because it is water-soluble, easily runs off into **ground water.** Phosphorus, because it bonds with the soil, becomes a greater problem when there is erosion. Urban runoff is not as obvious as agricultural runoff, but it is still a large part of non-point source pollution because of automotive pollution. Lead, zinc, nickel, and copper are some of the pollutants left behind from vehicles that travel on city streets, and they are all swept away during rainstorms. Contaminants get washed either into sewage collection systems or directly into a nearby water supply. These chemicals also can be deadly to aquatic life, harming the underwater environment further. *Activities One and Two* will further students' understanding of the different sources of pollution.

Aside from the damages caused by point source and NPS pollution, water quality is also degraded by erosion and sedimentation. Fast-moving streams and rivers naturally carry sediments through these waterways, but practices like farming and logging may accelerate the process. Not only does displacement of sediment change the ecosystem of the stream or river, but chemical and biological pollutants adhere to the sediment that moves with the water, ultimately spreading that pollution as well.

The Clean Water Act Protects Water Resources

The passage of and amendments to the Clean Water Act of 1972 established the basis for regulation of the release of pollutants into the waters of the U.S. The Clean Water Act also granted powers to the United States Environmental Protection Agency (EPA) to monitor and implement programs to reduce pollutants discharged by industries and municipalities. (http://www.epa.gov/region5/water/cwa.htm).

The Commonwealth of Virginia is required to develop and implement standards of quality for all of the waters of the state. These values, knows as the Water Quality Standards, represent the maximum allowable levels of various contaminants that may exist in the water. To comply with the Clean Water Act, every couple of years states are required to assess the quality of all bodies of water versus these standards. If the actual concentration of any particular contaminant exceeds the standard in a given water body, the water body is deemed to be impaired with respect to that pollutant and it is added to a list. The state is required to develop and implement Total Maximum Daily Loads, commonly known as TMDLs (USGS), for all impaired water bodies. These are calculations of the maximum amount of specific pollutants that a particular body of water can receive in one day and still remain within the standard. If Water Quality Standards are exceeded, the water could make people ill with minor to serious health problems. As of 1998, 31 streams in the Roanoke River Basin were listed as impaired due to unacceptable levels of **fecal coliform** (Roanoke).

Ways to Protect Water Resources

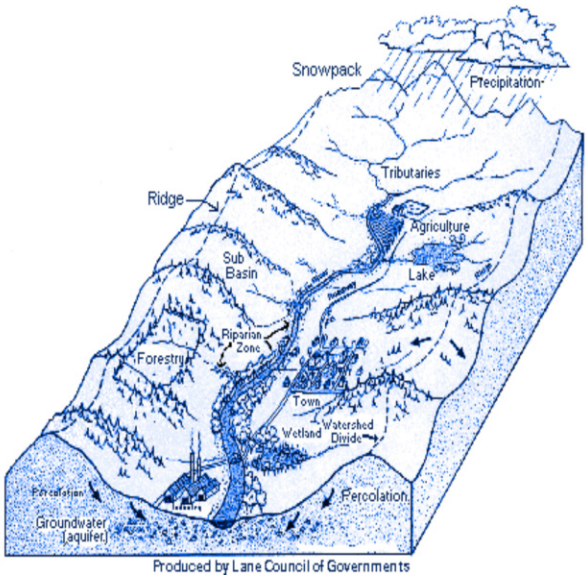
You may wonder what you can do to reduce or prevent water pollution. First, follow directions. When you are using a chemical or substance that is potentially harmful to the environment, always read and follow the directions. Be aware of both the proper application and disposal practices. For example, when you are oiling the chain on your bike, it is a good idea to use a rag to help to soak up some of the excess oil or lubricant, rather than just allowing it to leak on to the ground. It is also a good idea to dispose of the rag in a proper receptacle.

Apply fertilizers and pesticides to your lawn only as needed and when there is no sign of rain in the forecast to lessen the chance of runoff. When walking your pets, properly dispose of their waste. If your yard is adjacent to a stream, create a buffer of vegetation along the stream banks to prevent erosion. For help in creating riparian buffers in your community, see the Chesapeake Bay Foundation website below.

Litter is another major factor to consider when referring to water pollution. Water pollution does not just come in the form of chemicals and pesticides; trash accumulates in our waterways, which can have a serious negative effect. Be sure to dispose of your trash in the proper places. You can encourage your parents and neighbors to adopt a nearby road or section of a park and get together monthly to help keep it clean. To help prevent erosion and sediment runoff, insist that your parents seed those bare spots in your yard. For other ideas, please go to the Chesapeake Bay Foundation's website at, http://www.cbf.org/site/PageServer?pagename=resources_pubs_index, particularly "Fix Your Schoolyard Bare Spots" and "Build Your Own Rain Garden."

Another method of helping is to form or join an interest group to educate farmers and other individuals who own livestock about the harms done when livestock are allowed to roam through tributaries, streams, creeks, or rivers. Many farmers or ranchers may not know of the damage they are contributing to downstream. To learn more about organizations that help protect our water, and see what you can do see *Activities Three and Four*.

Occoquan River Case Study



A prime example of the positive results of sustainable development practice and community cooperation is that of the Occoquan River. The Occoquan River is a major **tributary** to the Potomac River which feeds the Chesapeake Bay. It provides a border between Prince William and Fairfax counties. The name Occoquan means "at the end of the water," and was given to the river and town by the Native Americans that settled the area. The River also lays claim to the largest **reservoir** system in the United States. The Occoquan Reservoir provides drinking water for 750,000 Northern Virginia residents through the use of purified wastewater.

The river has not always been this healthy for people or wildlife. During the 1960s and 1970s water in the Occoquan Reservoir was so polluted that residents noticed an odor and taste in their drinking water. Fish were unable to survive, and recreational boat traffic in the river declined dramatically. Since that time, extreme efforts have been implemented to clean up the

river and reservoir. The waste that flows into the Occoquan is now processed by one of the most advanced treatment plants in the nation.

The watershed area of the Occoquan is an area of particular concern to water resource managers. A **watershed** is a geographic area in which water, sediments, and other materials drain into a common body of water. The Occoquan River, along with the reservoir and surrounding land, makes up the Occoquan watershed and encompasses Loudoun, Prince William, Fairfax, and Fauquier counties. Due to increased urbanization and development, Fairfax County has developed a plan to protect the Occoquan Watershed. They have decided to "downzone" approximately 41,000 acres of land. This land is sanctioned as Residential-Conservation, which means that houses must be built on five-acre lots. This downzone limits the number of people able to populate the area around the watershed. This protects the water quality of the watershed by not allowing over-population, and ensures only a minimum of pollution reaches the region's water supply. *Activities Five and Six* further emphasize the Occoquan River and purifying of water for human consumption.

Many of us have seen or heard about some form of water pollution. It may have been hearing news coverage on the latest oil spill, or helping to cleaning up trash near a local stream or river. Human intervention to clean up waterways is important, but so is one of nature's best forms of cleaning up our waterways: **wetlands.**

A wetland is an area where the water table is very near the surface of the soil, which means the water doesn't sink into the ground like most places. **Surface water** lingers on the surface where you can see and touch it or it is very close to the surface. There are three things that must be present in order for an area to be considered a wetland. The first is that the plants must have the ability to grow, compete, and reproduce in anaerobic soil (soil without oxygen) conditions, which is called hydrophytic vegetation. The second condition, **hydric** soils, is the presence of soils in the area that are saturated or flooded long enough during the growing season, enabling these anaerobic conditions to develop. The final condition is called wetland hydrology, which is that the there has to be enough water to create both the hydric soils and the **hydrophytic** vegetation. If you have ever visited a swamp or marsh, you may have noticed your shoes sinking down into the soil because the land around the water was very soft and moist.

Wetlands vary in their physical and chemical factors. Physical features include soil type, topography, climate, hydrology, vegetation, and human disturbances. They also include microbes, aquatic and terrestrial animals, including insects, shellfish, fish, reptiles, amphibians, migratory birds, and mammals. Chemical factors include water chemistry and nutrient cycles.

What are the categories of wetlands? The two main categories of wetlands are coastal/tidal wetlands and inland/non-tidal wetlands. Coastal wetlands are linked to estuaries where seawater and freshwater are mixed, resulting in mixed salinated (brackish) environments and varied water levels. Due to these mixed levels, coastal wetlands are vegetated with grasses, grass-like plants, mangrove swamps, and salt-loving shrubs. Inland wetlands form along rivers and streams in the floodplains, in isolated land depressions, along areas of low land where groundwater meets the surface such as lakes and ponds, or where rain saturates the ground. Vegetation includes herbaceous plants, shrubs, and wooded swamps.

Wetlands are often thought of as wastelands and obstacles in the way of progress. In the past, much work was done to drain, dredge, and fill these low-lying areas. Once we better understood the function of wetlands in filtering water and the unique habitat they provide for plants and animals, laws were passed to protect and preserve them. One practice is a strategy called mitigation. If a wetland is destroyed by a project, such as a highway, then it must be replaced with a comparable human-made one. Destroying one wetland to complete a desired project just means you have to put another in. This no-net loss policy has helped. However, creating a wetland is much more complicated than that. There has been a great loss of wetlands as scientist learn how to recreate replacement ecosystems.

Why are wetland losses so alarming? Wetlands are home to many different types of animals and plants. Approximately one-third of the U.S. Endangered Species live only in wetlands, and over one-half visit a wetland at some point. Animals depend on wetlands for food, shelter, nesting sites, resting while migrating, and raising their young. Roots of vegetation in wetlands also serve to protect against floods by capturing, storing, and slowly releasing water. Along the coast, erosion from storms is prevented by vegetation that dissipates more than half of the energy caused by waves. Wetlands also serve as a filtering tool by which sediment, pollution, and excess nutrients are trapped in the wetland, sending clean water to the aquifer to replenish the groundwater. The peat biomass in wetlands serves to sequester carbon in the form of CO2, which prevents its release to the atmosphere, helping prevent global warming. More notable to most humans, wetlands provide a scenic view for bird and mammal watchers, as well as a site to grow food. To find out about wetlands near you, or further discuss the economic impacts of wetland depletion; refer to *Activities Seven and Eight.*

Did You Know?

- You can live for weeks without food, but only a few days without water!
- On average, each American uses 80-100 gallons of water per day in their homes!
- You need four to five gallons of water a day to survive!
- A quarter of the world's population doesn't have access to clean drinking water!
- 65 percent of the Earth's surface is water!
- 97 percent is salt water, two percent are contained in ice caps!
- That leaves only one percent for all species to use!
- One gallon of used motor oil can pollute nearly two million gallons of water!

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5.4 Materials List

5 – 1 Point Source vs Non-Point Source Pollution

- None

5 – 2 Journal of Pollution

- Pencil
- Paper

5 – 3 Presentation of Water Quality Organizations

- Computers

5 – 4 Curbing Water Pollution

- Pencil
- Paper

5 – 5 Occoquan River Video

- VHS Player

5 – 6 Field Trip

- None

5 – 7 Locating Wetlands in Your Area

- Computers
- Topographic Maps

5 – 8 Rural County, Virginia – Case Study

- Attached Worksheet

5 – 9 Wetlands Cost/Benefit Analysis

- Attached Worksheet

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5.5 Activities

5 – 1 ***Point Source vs Non-Point Source Pollution***

Students discuss the differences between PS and NPS Pollution, specifically the ability to regulate these two forms of pollution.

5 – 2 ***Journal of Pollution***

After the discussion in 5 – 1, students will keep a journal of different pollution they see. A class list will then be compiled, followed by a discussion of which type of pollution the students find more threatening.

5 – 3 ***Presentation of Water Quality Organizations***

Often people become interested in a cause, but do not feel they can make a difference. This activity will allow students to research and share information about various organizations involved in improving water quality.

5 – 4 ***Curbing Water Pollution***

Classmates will brainstorm together possible methods of decreasing pollution and increasing the quality of the environment around water bodies in their area.

5 – 5 ***Occoquan River Video***

A video about the Occoquan River helps to tie all of the ideas covered in class with this real life example.

5 – 6 ***Field Trip***

Plan a field trip to a local body of water or wastewater treatment plant.

5 – 7 ***Locating Wetlands in Your Area***

Obtain topographical maps to identify wetlands in your area, then have students observe various types of leaves, feathers, etc. from the area to identify organisms common to that ecosystem.

5 – 8 ***Rural County, Virginia – Case Study***

Attached worksheet provide a review of wetland information and tools to identify costs and benefits of development in an area designated as wetlands.

5 – 9 ***Wetlands Cost/Benefit Analysis***

Attached worksheet to identify costs and benefits of development in an area designated as wetlands.

5 – 1 *Point Source vs Non-Point Source Pollution*

Purpose

Have students discuss the differences between PS and NPS Pollution, specifically the ability to regulate these two forms of pollution.

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5 – 2 *Journal of Pollution*

Purpose

Students will keep a journal of water pollution they see on a daily basis to be able to recognize as PS or NPS.

Procedure

- Once students have created a significant list, compile the class data.
- Identify the sources of pollution as point source or non-point source.
- After the sources have been classified, lead a discussion of what the class feels is the more threatening type of pollution.

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5 – 3 *Presentation of Water Quality Organizations*

Purpose

Have the class divide into groups and investigate environmental and industrial organizations active in water conservation and improving water quality. Students can gain valuable information from these organizations on how to become involved in clean up in their own area. Once research is complete, students may present their organization to their peers. Use the data chart, *Environmental Professionals in Your Community (XIV. Environmental Professional.pdf)* to create a local directory.

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5 – 4 *Curbing Water Pollution*

Purpose

To discuss and develop methods of reducing water pollution.

Procedure

- Students should break into groups and brainstorm different ways in which they could contribute to curbing pollution in rivers and bodies of water.
- Discuss the methods each group chose. Utilize the blackboard to post all of the ideas for the class to see.
- Compare and contrast the methods with the students.
- Once the ideas are posted, pick two or three that would appear to be the best means of decreasing the amount of pollution in the water. Students should be involved in choosing these strategies and encouraged to implement them.

  Consult *Aquatic Stewardship (www.vanaturally.com/va_environment.html)*, a guide to water stewardship resources in Virginia.

5 – 5 *Occoquan River Video*

Purpose

Use a case study to review what was learned throughout this Window.

Procedure

- Students should view Dave Eckert's "Reclaiming our Water: The Occoquan River Watershed." Contact the Center for Economic Education at Virginia Tech for a free copy of the video: 218 Hutcheson Hall – 0401, AAEC Department, Virginia Tech, Blacksburg, VA 24061, 540-231-7722

- Afterwards, students should write a report addressing the factors that led to pollution of the river (i.e., farms, suburbs, shopping centers) and methods implemented to reduce the negative effects of these factors.

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5 – 6 *Field Trip*

Purpose

Visit local bodies of water or water treatment facilities in the area.

Procedure

- Take students to a local body of water that plays an important role in the natural and human environment.
- Have students identify possible sources of pollution to the water and help in collecting any apparent trash nearby.

or

- Plan a trip to a wastewater treatment facility so students are able to see the effects of pollution, and how water is purified for human use. Consult *Environmental Professionals in Your Community (XIV. Environmental Professional.pdf)* and *Aquatic Stewardship (www.vanaturally.com/va_environment.html)* for more information.

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5 – 7 *Locating Wetlands in Your Area*

Procedure

- Obtain a topographical map and have students find the low-lying areas around them. (You may obtain topographic maps from local marinas or fishing tackle shops or order National Wetlands Inventory maps from USGS/ESIC, 507 National Center, Reston VA 22092 or call 1-800-USA-MAPS.) Local Wetlands can also be found by visiting the USGS MapViewer Site. (http://nationalmap.usgs.gov/nmjump.html). Have students zoom to their county by mapping out local highways or water bodies. Next, have them click the arrow on the right hand side next to "Hydrography," and then check the box next to "Wetlands" and click "Redraw Map."

- Obtain permission to go to wetland areas. Compare and contrast the different plant life that exists in the two different geographical areas. The USGS has a brochure, "Wetland" (April 1998), available through the National Association of Conservation Districts (1-800-825-5547 or 408 East Main; P.O. Box 855; League City, TX 77574-0855) that offers tips on constructing backyard wetlands.

5 – 8 *Rural County, Virginia – Case Study*

Purpose

The students will discuss the balancing development and environmental concerns.

Background

The following should be used as a review of the information covered in the content section. It also serves as a tool for helping students understand the costs and benefits of development in an area designated as wetlands.

What is a wetland?

Wetlands are defined as any area of land that contains hydric soils and plants and is covered by water at least for part of the year. They exist in all sorts of environments from the tropics to the subarctic.

Wetlands perform many beneficial functions for the environment and for people including:

- *Groundwater recharge:* As needed, water from a wetland soaks into the ground to become groundwater, which humans may then process for consumption.
- *Flood Protection:* Wetlands slow down the rate at which water moves, helping to prevent the damage caused by fast-moving water.
- *Improved water quality: Nutrient* removal and toxic substance removal.
- *Wildlife diversity:* Only 20 percent of America's breeding birds do not depend on wetlands.
- *Recreation:* Many people enjoy fishing and hunting in wetlands.

Why should I care about wetlands?

All of these assets can be considered *renewable resources*. If the ecosystem is protected, it will continue to provide these resources for a long time. Humanity has not come up with efficient ways of reproducing these benefits, so we rely on the environment to keep providing us with clean air, water, and soil. Unfortunately wetlands, as well as other valuable ecosystems, are often destroyed by human development and actions. It is difficult for people to place a value on an ecosystem that does not have an obvious price. This becomes even more difficult when these ecosystems are compared to development projects that have clear payoffs.

Where do we go from here?

This lesson describes a hypothetical road and county that are experiencing a high rate of development and lie along a wetland. After the county description, there is a section on balancing development and the environment.

For a long time, Rural County remained a fairly isolated place; there were few businesses for miles. It was a small community where everyone knew each other. Rural County has a city to its east and west, about 30 miles away. These cities are growing and more people are moving to Rural and commuting to work, which is convenient considering the interstate that runs through the county. With the increasing population (now 15,000 people) and the commuting between the two cities, Rural has decided it would benefit by building a few restaurants, housing developments, a golf course, tourist attractions, gas station, and some rest areas along one of its main roads. Alongside this road is a marsh. This marsh has been known to be the habitat of bald eagles and other endangered animal and plant species. Since the beginning of construction of these new sites, the quality of the water in the

marsh and its tributaries has seriously declined. Some streams have turned orange from eroded sediment. Still others have giant algal blooms caused by the fertilizers that have run off the new golf course.

What is the county to do? If new development has brought a lot of money into the county, that is going to be used to provide new services and build better schools, does this marsh in the middle of nowhere really matter? Is there some compromise that can be made between the environment and the development?

How can we protect wetlands or other ecosystems and still benefit from a growing economy?

While the best protection for a wetland is usually to be left alone, there are various ways for developers to minimize the effects they have on wetlands. Some of these methods include:

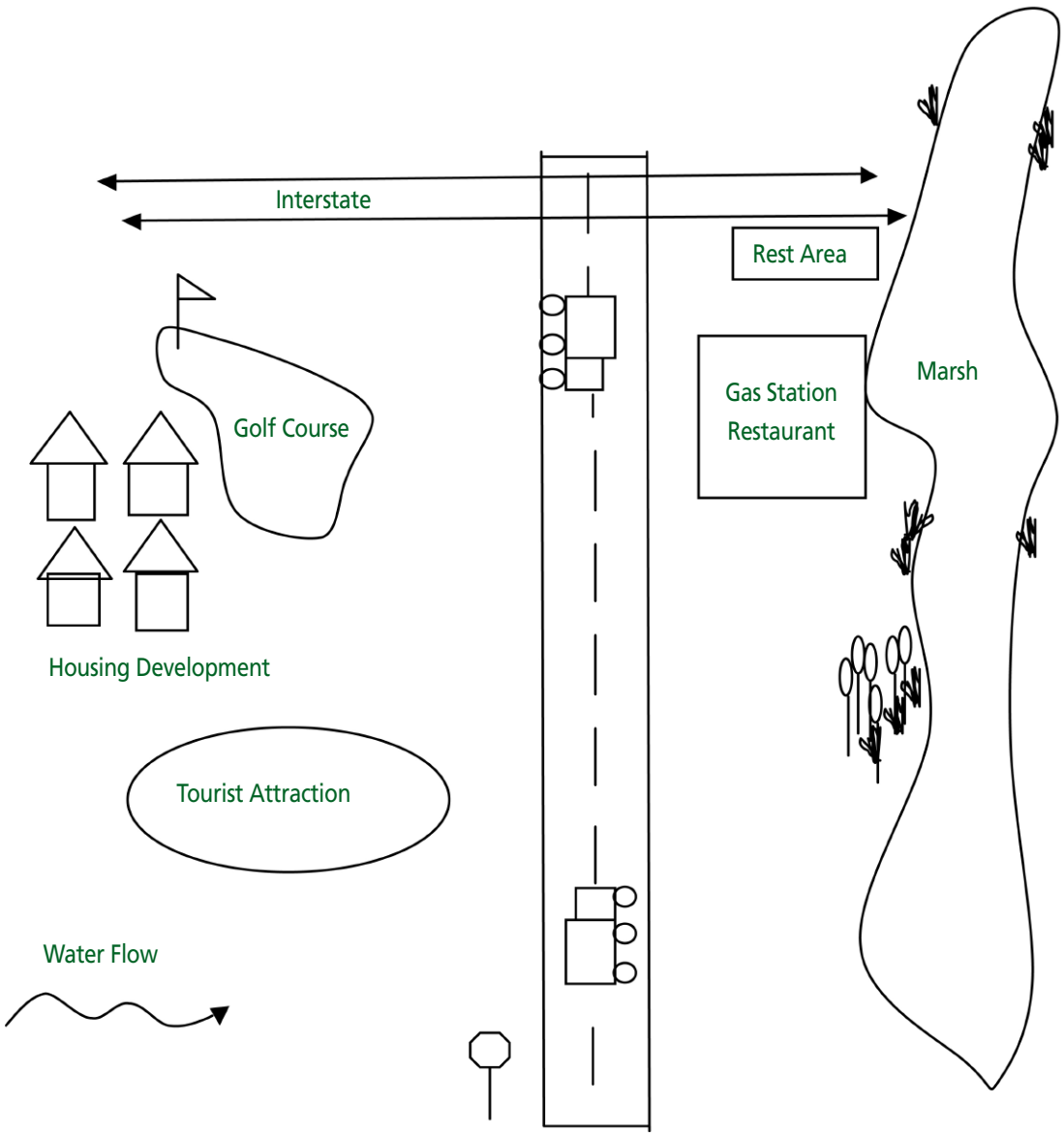
- Best Management Practices – These are methods that can be used by different kinds of industry (municipalities, farmers, etc.) to prevent or reduce pollution.
- Careful Water Quality Monitoring – Water quality monitoring during development is a great way to track its effects on the wetland and to maintain awareness before a problem exists.
- Smart Growth – This is a method that incorporates the idea that areas can grow while the environment is protected. It involves the following practices: compact building, preservation of open space, community cooperation, and many more earth-friendly practices.

Procedure

Have the students select sides and discuss (debate) the Rural County issue. Have each side present its case: one side can defend the community's need for revenue and jobs and the other can argue for the preservation of the wetland.

Development examples: Road in Rural County, Virginia Rest Area on Interstate, Golf Course, Housing Development, Gas Station, Restaurant, Tourist Attraction(s). *(Diagram page V:14)*

Diagram ***Development Road, Rural County, Virginia***



5 – 9 *Wetlands Cost/Benefit Analysis*

Procedure

Have the students complete the attached worksheet, and then discuss the results. While actual valuation of an ecosystem is much more complicated, this worksheet serves to help students place a price on environmental resources.

Worksheet

Wetlands

1. How much would you pay to see a bald eagle or other type of wetland bird? $ _____
2. How much would you pay for your children to be able to see a bald eagle or other wetland bird? $ _____
3. How much would you pay for clean drinking water for a year? $ _____
4. How much would you pay to be able to fish in the streams and tributaries and hunt for a year? $ _____

A. How much is a wetland worth to you? (Total 1-4) $ _____

B. How much is a wetland worth to Rural County? (Line A multiplied by 15,000 people) $ _____

Development

1. How much would you spend at that restaurant over a year? $ _____
2. How much would you spend at the golf course over a year? $ _____
3. How much would you spend to live next to a golf course? $ _____
4. How much would you pay to visit a tourist attraction, for example, an amusement park? $ _____

A. How much is Rural County's development worth to you? (Total 1-4) $ _____

B. How much is development worth to Rural County? (Line A multiplied by 15,000 people) $ _____

Reflection

Which value is higher for you, wetlands or development?

Do you think the results could be different for other people?

What costs not mentioned in this worksheet do you think should be considered for each of these topics?

Does it surprise you that one study estimated the costs of Canadian wetlands to be $60,704 per acre?

5.6 Assessment

The following are possible questions that may be used to evaluate the students' understanding of material covered:

1. Where does the majority of the runoff in your area originate? Where does it go? How might it be harmful to the environment?

2. What are some other threats to water quality and how could they be remedied?

3. Locate the Occoquan River on a map of the Northern Virginia area.

4. Explain what a watershed is and how its role in the environment makes keeping it clean so important.

   Answer: A geographic area where water, sediments, and other components drain into a common body of water. Keeping a watershed clean is of importance, because everything, including pollution, that starts in the watershed will eventually make it to and collect in the common body of water.

5. List the three conditions for an area to be considered a wetland.

   Answer: plants grow in anaerobic conditions, hydric soils, wetland hydrology (hydric soil and hydrophytic plants)

6. Describe the two categories of wetlands, being sure to list organisms you would find in each.

   Answer: Coastal/tidal – grasses, salt-loving plants, mangrove swamps
   Inland/non-tidal – herbaceous shrubs, wooded swamps

7. What are the functions of vegetation in a wetland system?

   Answer: flood protection, erosion control

8. What human introduced factors threaten the survival of a wetland?

   Answer: pollution, dams increasing/decreasing water flow, development wipes out habitat, over-fishing can offset balance of species

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